

1 1. (Thrice Amended) A method for detecting a threshold temperature in an  
2 integrated circuit comprising the steps of:  
3 generating a voltage reference that is substantially independent of a  
4 temperature of the integrated circuit;  
5 receiving at least one programmable input specifying a value  
6 corresponding to a threshold temperature for the integrated circuit;  
7 generating a sensing voltage that varies substantially linearly with the  
8 temperature of the integrated circuit;  
9 scaling the sensing voltage in accordance with the value to generate a  
10 comparison voltage, wherein the comparison voltage is substantially equal to  
11 the voltage reference when the temperature of the integrated circuit is  
12 substantially the same as the threshold temperature; and  
13 generating a signal when a difference between the comparison voltage  
14 and the voltage reference indicates the integrated circuit has attained said  
15 threshold temperature.  
16 [generating a voltage reference that is substantially constant over a  
17 range of temperatures of said integrated circuit;  
18 receiving at least one programmable input that specifies a threshold  
19 temperature for said integrated circuit;  
20 generating a sensing voltage wherein said sensing voltage amplitude  
21 exhibits a substantially linear relationship with said temperature of said  
22 integrated circuit;  
23 generating a scale factor based on said programmable input;

35

24 scaling said sensing voltage based on said scaling factor to generate a  
25 comparison voltage such that when said integrated circuit attains said  
26 threshold temperature said comparison voltage is substantially equal to said  
27 voltage reference;  
28 comparing said voltage reference to said comparison voltage; and  
29 generating a signal when said comparison voltage exceeds said voltage  
30 reference to indicate said integrated circuit temperature attained said  
31 threshold temperature.]

1 2. (Twice Amended) The method of claim 1 wherein the step of generating  
2 the voltage reference further comprises the step of generating a silicon  
3 bandgap voltage reference. [as claimed in claim 1 further comprising the step  
4 of programming a threshold temperature by specifying said programmable  
5 input.]

1 3. (Twice Amended) The method of claim 1 wherein the step of generating  
2 the sensing voltage further comprises the step of generating a base-to-emitter  
3 voltage ( $V_{be}$ ) from a bipolar transistor. [as claimed in claim 2 wherein:  
4 the step of generating a constant voltage reference comprises the step  
5 of generating a silicon bandgap voltage reference; and  
6 the step of generating a sensing voltage comprises the step of  
7 generating a base to emitter voltage ( $V_{be}$ ) from a bipolar transistor.]

36

1 4. (Twice Amended) The method of claim 3 wherein the step of scaling the  
2 sensing voltage further comprises the step of selecting a bias of the bipolar  
3 transistor in accordance with the value.  
4 [as claimed in claim 3 wherein the step of scaling said sensing voltage  
5 comprises the step of providing a plurality of resistive elements, wherein a  
6 first resistive element is coupled from the base to the collector of said bipolar  
7 transistor, and a second resistive element is coupled from the base of said  
8 bipolar transistor to ground, wherein said first resistive element and said  
9 second resistive element generate a scale factor for scaling said sensing  
10 voltage.]

1 5. (Twice Amended) The method of claim 4 further comprising the steps of:  
2 providing a first resistive element coupled to a base and a collector of  
3 the bipolar transistor;  
4 providing a plurality of series coupled resistors to form a second  
5 resistive element coupled to the base and an emitter of the bipolar transistor;  
6 and  
7 shorting a combination of the plurality of series-coupled resistors in  
8 accordance with the value to select the bias of the bipolar transistor.  
9 [as claimed in claim 4 wherein the step of programming a threshold  
10 temperature by specifying a scale factor comprises the steps of:  
11 coupling a plurality of resistors in series to generate said second  
12 resistive element;

13 coupling, across each resistor in said second resistive element, a  
14 transistor; and  
15 selectively biasing each transistor so as to select a combination of said  
16 resistors in said second resistive element to specify said scale factor for scaling  
17 said sensing voltage.]

1 6. (Twice Amended) The method as claimed in claim 5 wherein [said] the  
2 plurality of resistors comprises a plurality of binary weighted resistors.

1 7. (Twice Amended) The method as claimed in claim 1 wherein [said] the  
2 integrated circuit comprises a microprocessor.

1 8. (Thrice Amended) An apparatus for detecting a threshold temperature in  
2 an integrated circuit comprising:

3 voltage reference means for generating a voltage reference substantially  
4 independent of a temperature of the integrated circuit;

5 at least one programmable input for receiving a value corresponding to  
6 a threshold temperature of the integrated circuit;

7 temperature sensing means for generating a sensing voltage wherein  
8 the sensing voltage varies substantially linearly with the temperature of the  
9 integrated circuit, the temperature sensing means scaling the sensing voltage  
10 in accordance with the value to generate a comparison voltage, wherein the  
11 comparison voltage is substantially equal to the voltage reference when the  
12 integrated circuit attains the threshold temperature; and

13 comparison means coupled to the temperature sensing means and the  
14 voltage reference means, wherein the comparison means generates a signal  
15 when the comparison voltage exceeds the voltage reference to indicate the  
16 integrated circuit temperature attained the threshold temperature.

17 [voltage reference means for generating a voltage reference that is  
18 substantially constant over a range of temperatures of said integrated circuit;  
19 at least one programmable input for receiving a threshold temperature  
20 for said integrated circuit;

21 temperature sensing means for generating a sensing voltage wherein  
22 said sensing voltage amplitude exhibits a substantially linear relationship  
23 with said temperature of said integrated circuit, said temperature sensing  
24 means including scaling means generating a scale factor based on said  
25 programmable input and for scaling said sensing voltage in accordance with  
26 said scale factor to generate a comparison voltage such that when said  
27 integrated circuit attains said threshold temperature said comparison voltage  
28 is substantially equal to said voltage reference; and

29 comparison means coupled to said temperature sensing means and  
30 said voltage reference means for comparing said voltage reference to said  
31 comparison voltage, and for generating a signal when said comparison  
32 voltage exceeds said voltage reference to indicate said integrated circuit  
33 temperature attained said threshold temperature.]

1 9. (Twice Amended) The apparatus of claim 8 wherein the voltage reference  
2 is a silicon bandgap voltage reference. [The apparatus as claimed in claim 8  
3 further comprising programming means for programming a threshold

4 temperature by specifying said programmable input a scale factor for scaling  
5 said sensing voltage.]

1 10. (Twice Amended) The apparatus of claim 8 wherein the temperature  
2 sensing means further comprises a bipolar transistor for generating a  
3 base-to-emitter voltage as the sensing voltage.

4 [The apparatus as claimed in claim 9 wherein:

5 said voltage reference means generates a silicon bandgap voltage  
6 reference; and

7 said temperature sensing means comprises a bipolar transistor for  
8 generating a base to emitter voltage ( $V_{be}$ ) for said sensing voltage.]

1 11. (Twice Amended) The apparatus as claimed in claim 10 further  
2 comprising a plurality of resistive elements, wherein a first resistive element  
3 is coupled from a base to a collector of the bipolar transistor, and a second  
4 resistive element is coupled from the base of said bipolar transistor to an  
5 emitter of the bipolar transistor. [wherein said scaling means comprises a  
6 plurality of resistive elements, wherein a first resistive element is coupled  
7 from the base to the collector of said bipolar transistor, and a second resistive  
8 element is coupled from the base of said bipolar transistor to ground, wherein  
9 said first resistive element and said second resistive element generate a scale  
10 factor for scaling said sensing voltage.]

1 12. (Twice Amended) The apparatus of claim 11 wherein the second resistive  
2 element comprises a plurality of series-coupled resistors, wherein at least one

3 transistor is coupled across each of some of the plurality of resistors, wherein  
4 a combination of the resistors is selected in accordance with the value.

5 [The apparatus as claimed in claim 11 wherein:

6 said second resistive element comprises at least one resistor;

7 said programming means comprises:

8 at least one transistor coupled across each resistor in said second

9 resistive element; and

10 biasing means for biasing each transistor so as to select a combination  
11 of said resistors in said second resistive element to specify said scale factor for  
12 scaling said sensing voltage.]

1 13. (Twice Amended) The apparatus [as claimed in 11 wherein said] of claim  
2 11 wherein the resistors comprise a plurality of binary weighted resistors.

1 14. (Twice Amended) The apparatus [as claimed in 8 wherein said] of claim 8  
2 wherein the integrated circuit comprises a microprocessor.

1 15. (Twice Amended) An apparatus for detecting a threshold temperature in  
2 an integrated circuit comprising:

3 a bandgap reference circuit providing a voltage reference substantially  
4 independent of a temperature of the integrated circuit;

5 a bipolar transistor providing a base-to-emitter voltage ( $V_{be}$ ) as a  
6 sensing voltage, wherein the sensing voltage varies substantially linearly  
7 with the temperature of the integrated circuit;

8 at least one programmable input receiving a value corresponding to a  
9 threshold temperature for the integrated circuit;  
10 a voltage divider coupled to the bipolar transistor, wherein the voltage  
11 divider scales  $V_{be}$  in accordance with the value to generate a comparison  
12 voltage, wherein the comparison voltage is substantially equal to the voltage  
13 reference when the temperature of the integrated circuit is substantially equal  
14 to the threshold temperature; and  
15 a comparator providing a signal when a difference between the  
16 comparison voltage and the voltage reference indicates that the threshold  
17 temperature has been attained.

18 [a silicon bandgap reference circuit that generates a silicon bandgap  
19 voltage reference, wherein said silicon bandgap voltage reference is  
20 substantially constant over a range of temperatures of said integrated circuit;

21 a bipolar transistor wherein a base to emitter voltage ( $V_{be}$ ) from said  
22 bipolar transistor generates a temperature sensing voltage of said integrated  
23 circuit;

24 at least one programmable input that receives a threshold temperature  
25 for said integrated circuit;

26 a voltage divider circuit coupled to said bipolar transistor that scales  
27 said  $V_{be}$  to generate a comparison voltage such that when said integrated  
28 circuit attains said threshold temperature, said comparison voltage is  
29 substantially equal to said silicon bandgap voltage; and

30 a comparator coupled to said collector of said bipolar transistor and to  
31 said voltage reference circuit that compares said silicon bandgap voltage to  
32 said comparison voltage, and that generates a signal when said comparison



33 voltage exceeds said silicon bandgap voltage to indicate said integrated circuit  
34 temperature attained said threshold temperature.]

1 16. (Twice Amended) The apparatus of claim 15 wherein the voltage divider  
2 comprises a first resistive element coupled from a base to a collector of the  
3 bipolar transistor and a second resistive element coupled from the base to an  
4 emitter of the bipolar transistor. [as claimed in claim 15 wherein said voltage  
5 divider circuit comprises a plurality of resistive elements, wherein a first  
6 resistive element is coupled from the base to the collector of said bipolar  
7 transistor, and a second resistive element is coupled from the base of said  
8 bipolar transistor to ground, wherein said first resistive element and said  
9 second resistive element generate a scale factor for scaling said  $V_{be}$ .]

1 17. (Twice Amended) The apparatus of claim 16 further comprising:  
2 a plurality of series-coupled resistors forming the second resistive  
3 element; and  
4 a plurality of transistors, at least one of each of the plurality of  
5 transistors coupled across one of the plurality of resistors, wherein the  
6 plurality of transistors select a combination of resistors in accordance with the  
7 value to provide a bias voltage for the bipolar transistor.  
8 [The apparatus as claimed in claim 16 further comprising:  
9 a plurality of resistors for said second resistive element;  
10 a plurality of transistors coupled in parallel with each resistor; and

43

11 a plurality of programming voltages input to said transistors for biasing  
12 said transistors so as to select a combination of said resistors in said second  
13 resistive element to specify said scale factor for scaling said sensing voltage.]

1 18. (Twice Amended) The apparatus [as claimed in 16 wherein said] of claim  
2 16 resistors comprise a plurality of binary weighted resistors.

1 19. (Twice Amended) The apparatus [as claimed in 15 wherein said] of claim  
2 15 wherein the integrated circuit comprises a microprocessor.

44